Early Learning – Primary Content Standards

for

Science

2008

State Board of Education of Ohio

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Foreword

In response to Amended Substitute House Bill 94 of 2001, the Ohio Department of Education's Office of Early Learning and School Readiness convened Ohio stakeholders to develop early learning content standards for science.

Membership for the science writing team was selected from a pool of nominees representing Ohio early childhood stakeholders. They included Head Start, public and private preschool teachers; program administrators; and faculty members from higher education teacher preparation institutions. The team was balanced to include representation from all geographic areas of the state, as well as ethnic diversity.

The early learning content standards describe essential concepts and skills that young children should know and be able to use at the end of their preschool experience. Based on research, these achievable prekindergarten indicators are relevant to all early learning experiences, regardless of setting (e.g., nursery school, preschool and family care) and are aligned to the kindergarten through 12th-grade indicators, benchmarks and standards that result in a seamless continuum of learning for children preschool through kindergarten and primary grades.

A draft of the early learning content standards for science was disseminated for review and focused feedback from experts within and outside of Ohio. It also was posted on the Ohio Department of Education Web site for broad public input. Based on review of feedback, final revisions to the science early learning content standards document were completed. The final document was adopted by the State Board of Education in December 2003.

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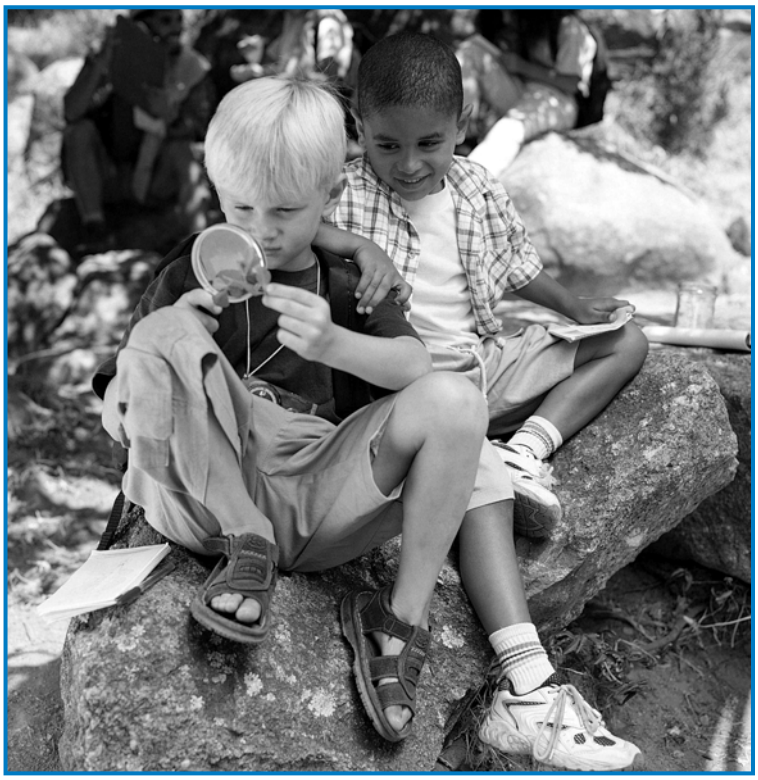

A scientist who lacks a sense of wonder and curiosity soon drops out of the race. Without curiosity, such scientists see no reason to seek answers, no reason to solve problems.

– Richard Feynman, 1988

Science

Overview

Science Standards

The Ohio science content standards provide all children and students in preschool through Grade 12 with a set of clear and rigorous expectations. The science standards focus on what all Ohio students need to know and be able to do for scientific literacy, regardless of age, gender, cultural or ethnic background, disabilities or aspirations in science.

The science standards include science concepts, processes and ways of thinking. All Ohio children and students can apply these skills and understandings to make informed personal decisions, to accurately communicate with a variety of audiences and to become lifelong learners. The standards also include expectations for the safe and effective use of technological tools for learning and doing science. The Ohio science content standards are listed below:

Content Standards:
- Earth and Space Sciences
- Life Sciences
- Physical Sciences
- Science and Technology
- Scientific Inquiry
- Scientific Ways of Knowing

The Ohio science standards identify essential expectations for students in concepts, principles, theories and processes of science. They describe broad areas of content such as the interdependence of organisms, the interactions of matter and energy, objects in the sky and the nature of scientific knowledge. The six standards address essential knowledge and skills in science that students may use to solve problems creatively, think critically, work cooperatively with others, use technology effectively and value lifelong learning.

The Ohio science content standards inform the design of teaching and learning opportunities that include accurate scientific information, scientific inquiry, technological design, communication and understanding of science concepts, analysis of data and application of concepts. Children and students' success in meeting the expectations of the standards depends on teaching and learning as an active inquiry process. This means that all teachers need the opportunity to teach science as something in which students are actively engaged. When participating in inquiry, learners describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge and communicate their ideas to others. This includes engaging all students with relevant, real-world activities that develop their knowledge, communication skills and scientific process skills.

The science standards enhance development of the learner's understanding of science concepts by combining scientific inquiry and technology studies with mathematical reasoning/analysis and language skills. Scientific literacy enables students to use scientific principles and processes to make decisions and to participate in discussions of scientific issues that affect society. Science instruction also can integrate knowledge and skills from disciplines such as mathematics, English language arts, social studies and other disciplines to develop conceptual frameworks that lead to broader understandings.

To describe the general framework of Ohio's standards, the following terms and definitions are used in this document:

Standard:	The standard statement describes, in broad terms, what children or students should know and be able to do as a result of the pre-school or kindergarten through grade 12 programs. A standard is an overarching goal or theme.
Benchmark:	Benchmarks are specific statements of what all students should know and be able to do at a specified time in their schooling. Benchmarks are used to measure a student's progress toward meeting the standards. Science benchmarks are defined for grade bands Pre-K-2, 3-5, 6-8, 9-10 and 11-12.
Grade-level Indicators:	Indicators serve as checkpoints that monitor progress toward the benchmarks.

A positive learning climate in a school for young children is a composite of many things. It is an attitude that respects children. It is a place where children receive guidance and encouragement from the responsible adults around them. It is an environment where children can experiment and try out new ideas without fear of failure. It is an atmosphere that builds children's self-confidence so they dare to take risks. It is an environment that nurtures a love of learning.

– Carol B. Hillman, 1989

Science Writing Team

The Ohio Department of Education, Office of Early Learning and School Readiness extends its appreciation and gratitude to the writing team members who contributed their expertise and time to the development of Ohio's early learning content standards for science. They devoted many hours to research and thoughtful consideration of issues to ensure the standards reflect wise and responsible thinking regarding early science teaching and learning. The writing team members represent the many caring and concerned individuals across the state dedicated to their profession and to high-quality early science education for all of Ohio's children.

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Introduction

Introduction

Ohio's science content standards serve as a basis for what all students should know and be able to do by the time they have graduated from high school. The vision for the broad learning goals of Ohio's science content standards provides for a scientifically literate citizen. These standards, benchmarks and grade-level indicators are intended to provide Ohio's educators with a set of common expectations upon which to base science curricula.

Ohio's Science Content Standards are intended to:

- Help students develop an understanding of the unity and diversity of the natural (empirical) world;
- Foster an understanding of the nature of science, the development of science processes, the principles of science, and the connections between the physical, life, and Earth and space sciences;
- Prepare students to use appropriate scientific processes and principles in making personal decisions;
- Enable students to engage intelligently in public discourse about matters of scientific and technological concern; and
- Increase their future economic productivity through the use of scientific knowledge, understanding and skills in their careers.

Ohio's Early Learning Content Standards are based upon principles that:

- Promote high expectations for scientific thinking and problem-solving for *all* students;
- Represent early science concepts and skills needed to provide a foundation for successful science instruction in the primary grades;
- Recognize the importance of children representing and demonstrating knowledge and understanding in multiple ways;
- Recognize the influence of diverse cultural and linguistic environments in science acquisition of young children;
- Represent essential concepts and skills that can be addressed within the context of meaningful experiences;
- Reflect sound application of research on how children acquire conceptual knowledge and skills in science;
- Serve as a framework for planning and implementing early science experiences within the context of daily routines, activities and play;
- Highlight the importance of children's extended and enhanced learning through in-depth engagement and exploration of concepts;
- Serve as the basis for classroom, program and state assessments; and
- Support an integrated approach to learning that is interactive and engaging for children.

Science for All

The Ohio Department of Education believes that Ohio's academic content standards are for all children and students. Clearly defined standards delineate what all college- and career-bound students should know and be able to do as they progress through the grade levels. Well-defined standards ensure that parents, teachers and administrators will be able to monitor children's development. Students, as stakeholders in their own learning, will be capable of tracking their own learning.

No individual or group should be excluded from the opportunity to learn, and all children are presumed capable of learning. Every Ohio student, regardless of race, gender, ethnicity, socioeconomic status, limited English proficiency, learning disability or giftedness, should have access to a challenging, standards-based curriculum.

The knowledge and skills defined in Ohio academic content standards are within the reach of all students. However, students develop at different rates. Given time and opportunity, all children learn and experience success, but the degree to which the standards are met and the time it takes to reach the standards will vary from student to student.

Students with disabilities should have Individualized Education Programs (IEPs) aligned with the standards. Children with disabilities are first and foremost, students of the general curriculum, yet they may require specific supports and interventions in varying degrees to progress in the curriculum. Accommodations and modifications provided to children with disabilities are not intended to compromise the content standards. Rather, these supports provide students the opportunity to maximize their strengths, compensate for their learning difficulties, and participate and progress in the standards-based curriculum.

Students who can exceed the grade-level indicators and benchmarks set forth in the standards must be afforded the opportunity and be encouraged to do so. Gifted and talented students may require special services or activities to fully develop their intellectual, creative, artistic and leadership capabilities or to excel in a specific content area.

Students with limited English proficiency (LEP) also may need specific supports and adaptive instructional delivery to achieve Ohio's content standards. An instructional delivery plan for the student with LEP needs to take into account the student's level of English language proficiency, as well as his or her cultural experiences.

Identifying and nurturing the talents of all students, and strategizing with students to address educational needs, will enable all children to reach the standards. The Ohio Department of Education encourages the early childhood community to align its educational programs with the standards to ensure that all Ohio's children reach their full potential.

The younger the children, the more the content of interaction should relate to their own first-hand experiences and real environment. With increasing age and experiences, children can and should be encouraged to develop their understanding of indirect experiences.

– Lilian Katz and Sylvia Chard, 2000

Science

Standards and Prekindergarten Indicators

Ohio's Preschool through Grade 12 Science Standards

The following standards provide guidance to early childhood educators across preschool and child care settings. Note how the standards for early childhood connect with those for grades kindergarten through 12.

Earth and Space Sciences

For Kindergarten through Grade 12

Students demonstrate an understanding about how Earth systems and processes interact in the geosphere, resulting in the habitability of the Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and the Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape the Earth and its history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences.

For Early Childhood

Young children are naturally interested in everything they see around them – soil, rocks, streams, rain, sand and shells. Science should include experiences that provide for the study of the Earth's materials and the discovery of their patterns and changes over time. Since children cannot interact directly with sky or space, learning experiences with the sky or space are based on observation. Preschool children learn about the Earth and space when they play shadow tag, talk about things they do during the day and at night, add water to dirt while making mud pies, and paint with water on the sidewalk and notice that the pictures soon disappear. Continuous opportunities to clean up their immediate space, the playground, and to collect and recycle materials support young learners' understanding about their role in respecting, protecting, preserving and caring for the natural world and environment. Children are very interested in the outdoor environment, naturally use it as a laboratory for learning, and enjoy drawing or charting what they see and think.

Life Sciences

For Kindergarten through Grade 12

Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students also will develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

For Early Childhood

Life science is about living things. Young children should be provided direct experiences with living things, their life cycles and their habitats. Although understanding is emerging, children develop concepts of living and non-living things, the behavior and needs of living things and respect for living things. Key ideas emerge from exploring the immediate environment. Therefore, a preschooler in Ohio might explore familiar plants and animals native to the area, studying how living things get food, their characteristics and how they change as they grow.

Physical Sciences

For Kindergarten through Grade 12

Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.

For Early Childhood

Physical science is the study of the physical properties of materials and objects. Through exploration of materials, children learn about weight, shape, size, color and temperature. They explore how things move and change. Beginning concepts develop as young children act on objects to produce a desired effect, put objects together to form new constructions of various kinds and draw conclusions about how the desired effect was produced. When children make a block ramp to race cars, look through a kaleidoscope or pick up objects with magnets, they are learning about the physical properties of objects.

Science and Technology

For Kindergarten through Grade 12

Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

For Early Childhood

For young children, central ideas and skills related to science technology include identifying simple and familiar tools such as a magnifying glass or hammer, using appropriate tools to explore objects and phenomena or solve a problem, and exploring creative uses for materials or objects. When preschool children appropriately use a hammer and a magnifying glass or use a paper towel roll as a telescope, they are learning about the importance and use of science technology.

Scientific Inquiry

For Kindergarten through Grade 12

Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students also are able to demonstrate the ability to communicate their findings to others.

For Early Childhood

Preschool children learn science by exploring the world around them. They develop an understanding of science as they investigate and interact with real objects and phenomena. Children should be provided with a variety of simple equipment, materials and opportunities for playing, questioning, exploring, demonstrating, investigating and experimenting. Through scientific processes of inquiry or seeking answers based on their curiosities, young children predict, observe, collect or chart information over time, and represent and formulate conclusions. Sharing books and stories, engaging in conversations and playing provide varied opportunities for exploration, discovery and the communication of findings.

Scientific Ways of Knowing

For Kindergarten through Grade 12

Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

For Early Childhood

Children's early impressions about who learns science and practices science appear to be persistent and lasting. For young children, science should be experienced in ways that actively engage young learners in the construction of ideas and explanations of doing science. Children's ideas and explanations, whether accurate or not, should be valued and serve as a basis for further investigation and discovery. Science should be modeled as an activity for all learners, where they individually and collectively contribute to a growing understanding of the natural world.

Science Prekindergarten Indicators

Earth and Space Sciences

The Universe

1. Begin to use terms such as night and day, sun and moon to describe personal observations.
2. Observe and represent the pattern of day and night through play, art materials or conversation.

Processes that Shape the Earth

3. Observe, explore and compare changes that animals and plants contribute to in their surroundings (e.g., humans building roads and houses, holes left by worms or squirrels).
4. Explore and compare changes in the environment over time (e.g., soil erosion, fossils, outdoor temperature).
5. Explore how their actions may cause changes in the environment that are sometimes reversible (e.g., hand in flowing water changes the current) and sometimes irreversible (e.g., rock dropped that breaks).
6. Demonstrate understanding of fast and slow relative to time, motion and phenomena (e.g., ice melting, soil eroding, water running quickly down a steep hill compared to running slowly down a gentle hill).
7. Observe and use language or drawings to describe changes in the weather (e.g., sunny to cloudy day).

Life Sciences

Characteristics and Structure of Life

1. Identify common needs (e.g., food, air, water) of familiar living things.
2. Begin to differentiate between real and pretend through stories, illustrations, play and other media (e.g., talking flowers or animals).

Diversity and Interdependence of Life	3. Observe and begin to recognize the ways that environments support life by meeting the unique needs of each organism (e.g., plant/soil, birds/air, fish/water).
Heredity	4. Match familiar adult family members, plants and animals with their young (e.g., horse/colt, cow/calf). 5. Recognize physical differences among the same class of people, plants or animals (e.g., dogs come in many sizes and colors).

Physical Sciences

Nature of Matter	1. Explore and identify parts and wholes of familiar objects (e.g., books, toys, furniture). 2. Explore and compare materials that provide many different sensory experiences (e.g., sand, water, wood). 3. Sort familiar objects by one or more property (e.g., size, shape, function).
Forces and Motion	4. Demonstrate understanding of motion-related words (e.g., up, down, fast, slow, rolling, jumping, backward, forward). 5. Explore ways of moving objects in different ways (e.g., pushing, pulling, kicking, rolling, throwing, dropping).
Nature of Energy	6. Explore musical instruments and objects and manipulate one's own voice to recognize the changes in the quality of sound (e.g., talk about loud, soft, high, low, fast, slow). 7. Explore familiar sources of the range of colors and the quality of light in the environment (e.g., prism, rainbow, sun, shadow).

Science and Technology

Understanding Technology

1. Identify the intended purpose of familiar tools (e.g., scissors, hammer, paintbrush, cookie cutter).
2. Explore new uses for familiar materials through play, art or drama (e.g., paper towel rolls as kazoos, pan for a hat).

Abilities to do Technological Design

3. Use familiar objects to accomplish a purpose, complete a task or solve a problem (e.g., using scissors to create paper tickets for a puppet show, creating a ramp for a toy truck).
4. Demonstrate the safe use of tools, such as scissors, hammers, writing utensils, with adult guidance.

Scientific Inquiry

Doing Scientific Inquiry

1. Ask questions about objects, organisms and events in their environment during shared stories, conversations and play (e.g., ask about how worms eat).
2. Show interest in investigating unfamiliar objects, organisms and phenomena during shared stories, conversations and play (e.g., Where does hail come from?).
3. Predict what will happen next based on previous experiences (e.g., when a glass falls off the table and hits the tile floor, it probably will break).
4. Investigate natural laws acting upon objects, events and organisms (e.g., repeatedly dropping objects to observe the laws of gravity, observing the life cycle of insects).
5. Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).
6. Explore objects, organisms and events using simple equipment (e.g., magnets and magnifiers, standard and non-standard measuring tools).

Doing Scientific Inquiry (continued)

7. Begin to make comparisons between objects or organisms based on their characteristics (e.g., animals with four legs, smooth and rough rocks).
8. Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance.

Scientific Ways of Knowing

Nature of Science

1. Offer ideas and explanations (through drawings, emergent writing, conversations, movement) of objects, organisms and phenomena, which may be correct or incorrect.

Ethical Practices

2. Recognize the difference between helpful and harmful actions toward living things (e.g., watering or not watering plants).

Science and Society

3. Participate in simple, spontaneous scientific explorations with others (e.g., digging to the bottom of the sandbox, testing materials that sink or float).

Science

Indicators by Standard

Prekindergarten – Kindergarten

Science Prekindergarten and Kindergarten Indicators

The following lists the prekindergarten and kindergarten indicators within each standard.

I. Earth and Space Sciences Standard

Prekindergarten	Kindergarten
• Begin to use terms such as night and day, sun and moon to describe personal observations.	• Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day.
• Observe and represent the pattern of day and night through play, art materials or conversation.	
• Observe, explore, and compare changes that animals and plants contribute to in their surroundings (e.g., humans building roads and houses, holes left by worms or squirrels).	• Explore that animals and plants cause changes to their surroundings.
• Explore and compare changes in the environment over time (e.g., soil erosion, fossils, outdoor temperature).	• Explore that sometimes change is too fast to see and sometimes change is too slow to see.
• Explore how their actions may cause changes in the environment that are sometimes reversible (e.g., hand in flowing water changes the current) and sometimes irreversible (e.g., rock dropped that breaks).	
• Demonstrate understanding of fast and slow relative to time, motion and phenomena (e.g., ice melting, soil eroding, water running quickly down a steep hill compared to running slowly down a gentle hill).	
• Observe and use language or drawings to describe changes in the weather (e.g., sunny to cloudy day).	• Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain).
	• Observe and describe seasonal changes in weather.

II. Life Sciences Standard

Prekindergarten

- Identify common needs (e.g., food, air, water) of familiar living things.
- Begin to differentiate between real and pretend through stories, illustrations, play and other media (e.g., talking flowers or animals).
- Observe and begin to recognize the ways that environments support life by meeting the unique needs of each organism (e.g., plant/soil, birds/air, fish/water).
- Match familiar adult family members, plants and animals with their young (e.g., horse/colt, cow/calf).
- Recognize physical differences among the same class of people, plants or animals (e.g., dogs come in many sizes and colors).

Kindergarten

- Explore differences between living and non-living things (e.g., plant-rock).
- Discover that stories (e.g., cartoons, movies, comics) sometimes give plants and animals characteristics they really do not have (e.g., talking flowers).
- Investigate observable features of plants and animals that help them live in different kinds of places.
- Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community.
- Describe how plants and animals usually resemble their parents.
- Investigate variations that exist among individuals of the same kind of plant or animal.

III. Physical Sciences Standard

Prekindergarten

- Explore and identify parts and wholes of familiar objects (e.g., books, toys, furniture).
- Explore and compare materials that provide many different sensory experiences (e.g., sand, water, wood).
- Sort familiar objects by one or more property (e.g., size, shape, function).
- Demonstrate understanding of motion-related words (e.g., up, down, fast, slow, rolling, jumping, backward, forward).
- Explore ways of moving objects in different ways (e.g., pushing, pulling, kicking, rolling, throwing, dropping).
- Explore musical instruments and objects and manipulate one's own voice to recognize the changes in the quality of sound (e.g., talks about loud, soft, high, low, fast, slow).
- Explore familiar sources of the range of colors and the quality of light in the environment (e.g., prism, rainbow, sun, shadow).

Kindergarten

- Demonstrate that objects are made of parts (e.g., toys, chairs).
- Examine and describe objects according to the materials that make up the object (e.g., wood, metal, plastic and cloth).
- Describe and sort objects by one or more properties (e.g., size, color, and shape).
- Explore that things can be made to move in many different ways such as straight, zigzag, up and down, round and round, back and forth, fast and slow.
- Investigate ways to change how something is moving (e.g., push, pull).

IV. Science and Technology Standard

Prekindergarten

- Explore new uses for familiar materials through play, art or drama (e.g., paper towel rolls as kazoos, pan for a hat).

Kindergarten

- Explore that objects can be sorted as "natural" or "man-made."
- Explore that some materials can be used over and over again (e.g., plastic or glass containers, cardboard boxes and tubes).

IV. Science and Technology Standard (continued)

Prekindergarten

- Identify the intended purpose of familiar tools (e.g., scissors, hammer, paintbrush, cookie cutter).
- Use familiar objects to accomplish a purpose, complete a task or solve a problem (e.g., using scissors to create paper tickets for a puppet show, creating a ramp for a toy truck).
- Demonstrate the safe use of tools, such as scissors, hammers, writing utensils, with adult guidance.

Kindergarten

- Explore that each kind of tool has an intended use, which can be helpful or harmful (e.g., scissors can be used to cut paper but they can also hurt you).

V. Scientific Inquiry Standard

Prekindergarten

- Ask questions about objects, organisms and events in their environment during shared stories, conversations and play (e.g., ask about how worms eat).
- Show interest in investigating unfamiliar objects, organisms and phenomena during shared stories, conversations and play (e.g., “Where does hail come from?”).
- Predict what will happen next based on previous experiences (e.g., when a glass falls off the table and hits the tile floor, it probably will break).
- Investigate natural laws acting upon objects, events, and organisms (e.g., repeatedly dropping objects to observe the laws of gravity, observing the life cycle of insects).
- Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).

Kindergarten

- Ask “what if” questions.
- Explore and pursue student-generated “what if” questions.
- Use the five senses to make observations about the natural world.
- Make new observations when people give different descriptions for the same thing.

V. Scientific Inquiry Standard (continued)

Prekindergarten

- Explore objects, organisms and events using simple equipment (e.g., magnets and magnifiers, standard and non-standard measuring tools).
- Begin to make comparisons between objects or organisms based on their characteristics (e.g., animals with four legs, smooth and rough rocks).
- Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance.

Kindergarten

- Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools).
- Use appropriate safety procedures when completing scientific investigations.
- Draw pictures that correctly portray features of the item being described.
- Recognize that numbers can be used to count a collection of things.
- Measure the lengths of objects using non-standard methods of measurement (e.g., teddy bear counters and pennies).
- Make pictographs and use them to describe observations and draw conclusions.

VI. Scientific Ways of Knowing Standard

Prekindergarten

- Offer ideas and explanations (through drawings, emergent writing, conversations, movement) of objects, organisms and phenomena, which may be correct or incorrect.
- Recognize the difference between helpful and harmful actions toward living things (e.g., watering or not watering plants).
- Participate in simple, spontaneous scientific explorations with others (e.g., digging to the bottom of the sandbox, testing materials that sink or float).

Kindergarten

- Recognize that scientific investigations involve asking open-ended questions. (How? What if?).
- Recognize that people are more likely to accept your ideas if you can give good reasons for them.
- Interact with living things and the environment in ways that promote respect.
- Demonstrate ways science is practiced by people every day (children and adults).

Science

Standards, Benchmarks and Indicators

Prekindergarten – Grade 2

Correlation of Benchmarks and Indicators
Prekindergarten — 2

NOTE: The term, *prekindergarten*, refers to all early learning experiences before kindergarten (e.g., nursery school, preschool, family care, etc.).

The number in parenthesis () corresponds to the numbered grade-level indicator found in section "Benchmarks and Indicators by Standard" of *Academic Content Standards: K-12 English Language Arts*.

Earth and Space Sciences Standard

Pre-K – 2 Benchmark

A. Observe constant and changing patterns of objects in the day and night sky.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Begin to use terms such as night and day, sun and moon to describe personal observations. (1) • Observe and represent the pattern of day and night through play, art materials or conversation. (2)	• Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day. (1)	No indicators present for this benchmark.	• Recognize that there are more stars in the sky than anyone can easily count. (1) • Observe and describe how the sun, moon and stars all appear to move slowly across the sky. (2) • Observe and describe how the moon appears a little different every day but looks nearly the same again about every four weeks. (3)

Correlation of Benchmarks and Indicators

Prekindergarten — 2

Earth and Space Sciences Standard

Pre-K – 2 Benchmark

B. Explain that living things cause changes on Earth.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Observe, explore and compare changes that animals and plants contribute to in their surroundings (e.g., humans building roads and houses, holes left by worms or squirrels). (3)	• Explore that animals and plants cause changes to their surroundings. (2)	• Explain that all organisms cause changes in the environment where they live; the changes can be very noticeable or slightly noticeable, fast or slow (e.g., spread of grass cover slowing soil erosion, tree roots slowly breaking sidewalks). (3)	No indicators present for this benchmark.

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Earth and Space Sciences Standard

Pre-K – 2 Benchmark

C. Observe, describe and measure changes in the weather, both long term and short term.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Explore and compare changes in the environment over time (e.g., soil erosion, fossils, outdoor temperature). (4) • Explore how their actions may cause changes in the environment that are sometimes reversible (e.g., hand in flowing water changes the current) and sometimes irreversible (e.g., rock dropped that breaks). (5) • Demonstrate understanding of fast and slow relative to time, motion and phenomena (e.g., ice melting, soil eroding, water running quickly down a steep hill compared to running slowly down a gentle hill). (6) • Observe and use language or drawings to describe changes in the weather (e.g., sunny to cloudy day). (7).	• Explore that sometimes change is too fast to see and sometimes change is too slow to see. (3) • Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain). (4) • Observe and describe seasonal changes in weather. (5)	No indicators present for this benchmark.	• Observe and describe that some weather changes occur throughout the day and some changes occur in a repeating seasonal pattern. (4) • Describe weather by measurable quantities such as temperature and precipitation. (5)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Earth and Space Sciences Standard

Pre-K – 2 Benchmark

D. Describe what resources are and recognize some are limited but can be extended through recycling or decreased use.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
No indicators present for this bench.	No indicators present for this bench.	• Identify that resources are things that we get from the living (e.g., forests) and nonliving (e.g., minerals, water) environment and that resources are necessary to meet the needs and wants of a population. (1) • Explain that the supply of many resources is limited but the supply can be extended through careful use, decreased use, reusing and/or recycling. (2)	No indicators present for this bench.

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Life Sciences Standard

Pre-K – 2 Benchmark

A. Discover that there are living things, non-living things and pretend things, and describe the basic needs of living things (organisms).

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Identify common needs (e.g., food, air, water) of familiar living things. (1) • Begin to differentiate between real and pretend through stories, illustrations, play and other media (e.g., talking flowers or animals). (2)	• Explore differences between living and non-living things (e.g., plant, rock). (1) • Discover that stories (e.g., cartoons, movies, comics) sometimes give plants and animals characteristics they really do not have (e.g., talking flowers). (2)	• Explore that organisms, including people, have basic needs which include air, water, food, living space and shelter. (1) • Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting. (4)	• Explain that animals, including people, need air, water, food, living space and shelter; plants need air, water, nutrients (e.g., minerals), living space and light to survive. (1) • Explain that food is a basic need of plants and animals (e.g., plants need sunlight to make food and to grow, animals eat plants and/or other animals for food, food chain) and is important because it is a source of energy (e.g., energy used to play, ride bicycles, read, etc.). (5)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Life Sciences Standard

Pre-K – 2 Benchmark

B. Explain how organisms function and interact with their physical environments.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Observe and begin to recognize the ways that environments support life by meeting the unique needs of each organism (e.g., plant/soil, birds/air, fish/water). (3)	• Investigate observable features of plants and animals that help them live in different kinds of places. (5) • Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community. (6)	• Explain that food comes from sources other than grocery stores (e.g., farm crops, farm animals, oceans, lakes and forests). (2) • Explore that humans and other animals have body parts that help to seek, find and take in food when they are hungry (e.g., sharp teeth, flat teeth, good nose and sharp vision). (3) • Recognize that seasonal changes can influence the health, survival or activities of organisms. (5)	• Identify that there are many distinct environments that support different kinds of organisms. (2) • Explain why organisms can survive only in environments that meet their needs (e.g., organisms that once lived on Earth have disappeared for different reasons such as natural forces or human-caused effects). (3) • Investigate the different structures of plants and animals that help them live in different environments (e.g., lungs, gills, leaves and roots). (6) • Compare the habitats of many different kinds of Ohio plants and animals and some of the ways animals depend on plants and each other. (7) • Compare the activities of Ohio's common animals (e.g., squirrels, chipmunks, deer, butterflies, bees, ants, bats and frogs) during the different seasons by describing changes in their behaviors and body coverings. (8) • Compare Ohio plants during the different seasons by describing changes in their appearance. (9)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Life Sciences Standard

Pre-K – 2 Benchmark

C. Describe similarities and differences that exist among individuals of the same kind of plants and animals.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Match familiar adult family members, plants and animals with their young (e.g., horse/colt, cow/calf). (4) • Recognize physical differences among the same class of people, plants or animals (e.g., dogs come in many sizes and colors). (5)	• Describe how plants and animals usually resemble their parents. (3) • Investigate variations that exist among individuals of the same kind of plant or animal. (4)	No indicators present for this bench.	• Compare similarities and differences among individuals of the same kind of plants and animals, including people. (4)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Physical Sciences Standard

Pre-K – 2 Benchmark

A. Discover that many objects are made of parts that have different characteristics. Describe these characteristics and recognize ways an object may change.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Explore and identify parts and wholes of familiar objects (e.g., books, toys, furniture). (1) • Explore and compare materials that provide many different sensory experiences (e.g., sand, water, wood). (2) • Sort familiar objects by one or more property (e.g., size, shape, function). (3)	• Demonstrate that objects are made of parts (e.g., toys, chairs). (1) • Examine and describe objects according to the materials that make up the object (e.g., wood, metal, plastic and cloth). (2) • Describe and sort objects by one or more properties (e.g., size, color and shape). (3)	• Classify objects according to the materials they are made of and their physical properties. (1) • Investigate that water can change from liquid to solid or solid to liquid. (2) • Explore and observe that things can be done to materials to change their properties (e.g., heating, freezing, mixing, cutting, wetting, dissolving, bending and exposing to light). (3) • Explore changes that greatly change the properties of an object (e.g., burning paper) and changes that leave the properties largely unchanged (e.g., tearing paper). (4)	No indicators present for this bench.

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Physical Sciences Standard

Pre-K – 2 Benchmark

B. Recognize that light, sound and objects move in different ways.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Demonstrate understanding of motion-related words (e.g., up, down, fast, slow, rolling, jumping, backward, forward). (4) • Explore ways of moving objects in different ways (e.g., pushing, pulling, kicking, rolling, throwing, dropping). (5)	• Explore that things can be made to move in many different ways such as straight, zigzag, up and down, round and round, back and forth, fast and slow. (4) • Investigate ways to change how something is moving (e.g., push, pull). (5)	• Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets). (5) • Investigate a variety of ways to make things move and what causes them to change speed, direction and/or stop. (6)	• Explore how things make sound (e.g., rubber bands, tuning fork and strings). (1) • Explore with flashlights and shadows that light travels in a straight line until it strikes an object. (3)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Physical Sciences Standard

Pre-K – 2 Benchmark

C. Recognize sources of energy and their uses.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Explore musical instruments and objects and manipulate one's own voice to recognize the changes in the quality of sound (e.g., talk about loud, soft, high, low, fast, slow). (6) • Explore familiar sources of the range of colors and the quality of light in the environment (e.g., prism, rainbow, sun, shadow). (7)	No indicators present for this bench.	• Explore how energy makes things work (e.g., batteries in a toy and electricity turning fan blades). (7) • Recognize that the sun is an energy source that warms the land, air and water. (8) • Describe that energy can be obtained from many sources in many ways (e.g., food, gasoline, electricity or batteries). (9)	• Explore and describe sounds (e.g., high, low, soft and loud) produced by vibrating objects. (2)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Science and Technology Standard

Pre-K – 2 Benchmark

A. Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Explore new uses for familiar materials through play, art or drama (e.g., paper towel rolls as kazoos, pan for a hat). (2)	• Explore that objects can be sorted as "natural" or "man-made." (1) • Explore that some materials can be used over and over again (e.g., plastic or glass containers, cardboard boxes and tubes). (2)	• Explore how some kinds of materials are better suited than others for making something new (e.g., the building materials used in the *Three Little Pigs*). (1) • Identify some materials that can be saved for community recycling projects (e.g., newspapers, glass and aluminum). (3) • Explore ways people use energy to cook their food and warm their homes (e.g., wood, coal, natural gas and electricity). (4) • Identify how people can save energy by turning things off when they are not using them (e.g., lights and motors). (5)	• Explain that developing and using technology involves benefits and risks. (1) • Investigate why people make new products or invent new ways to meet their individual wants and needs. (2) • Predict how building or trying something new might affect other people and the environment. (3)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Science and Technology Standard

Pre-K – 2 Benchmark

B. Explain that to construct something requires planning, communication, problem solving and tools.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Identify the intended purpose of familiar tools (e.g., scissors, hammer, paintbrush, cookie cutter). (1) • Use familiar objects to accomplish a purpose, complete a task or solve a problem (e.g., using scissors to create paper tickets for a puppet show, creating a ramp for a toy truck). (3) • Demonstrate the safe use of tools, such as scissors, hammers, writing utensils, with adult guidance. (4)	• Explore that each kind of tool has an intended use, which can be helpful or harmful (e.g., scissors can be used to cut paper but they can also hurt you). (3)	• Explain that when trying to build something or get something to work better, it helps to follow directions and ask someone who has done it before. (2) • Investigate that tools are used to help make things and some things cannot be made without tools. (6) • Explore that several steps are usually needed to make things (e.g., building with blocks). (7) • Investigate that when parts are put together they can do things that they could not do by themselves (e.g., blocks, gears and wheels). (8)	• Communicate orally, pictorially or in written form the design process used to make something. (4)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Scientific Inquiry Standard

Pre-K – 2 Benchmark

A. Ask a testable question.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Ask questions about objects, organisms and events in their environment during shared stories, conversations and play (e.g., ask about how worms eat). (1) • Show interest in investigating unfamiliar objects, organisms and phenomena during shared stories, conversations and play (e.g., "Where does hail come from?"). (2) • Predict what will happen next based on previous experiences (e.g., when a glass falls off the table and hits the tile floor, it probably will break). (3) • Investigate natural laws acting upon objects, events and organisms (e.g., repeatedly dropping objects to observe the laws of gravity, observing the life cycle of insects). (4)	• Ask "what if" questions. (1) • Explore and pursue student-generated "what if" questions. (2)	• Ask "what happens when" questions. (1) • Explore and pursue student-generated "what happens when" questions. (2)	• Ask "how can I/we" questions. (1) • Ask "how do you know" questions (not "why" questions) in appropriate situations and attempt to give reasonable answers when others ask questions. (2) • Explore and pursue student-generated "how" questions. (3)

Correlation of Benchmarks and Indicators

Prekindergarten — 2

Scientific Inquiry Standard

Pre-K – 2 Benchmark

B. Design and conduct a simple investigation to explore a question.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about). (5) • Explore objects, organisms and events using simple equipment (e.g., magnets and magnifiers, standard and non-standard measuring tools). (6)	• Use appropriate safety procedures when completing scientific investigations. (3) • Use the five senses to make observations about the natural world. (4) • Use appropriate tools and simple equipment/ instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools). (7) • Make new observations when people give different descriptions for the same thing. (10)	• Use appropriate safety procedures when completing scientific investigations. (3) • Use appropriate tools and simple equipment/ instruments to safely gather scientific data (e.g., magnifiers, timers and simple balances and other appropriate tools). (6)	• Use appropriate safety procedures when completing scientific investigations. (4) • Use appropriate tools and simple equipment/ instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances and calculators and other appropriate tools). (7) • Measure properties of objects using tools such as rulers, balances and thermometers. (8)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Scientific Inquiry Standard

Pre-K – 2 Benchmark

C. Gather and communicate information from careful observations and simple investigation through a variety of methods.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Begin to make comparisons between objects or organisms based on their characteristics (e.g., animals with four legs, smooth and rough rocks). (7) • Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance. (8)	• Draw pictures that correctly portray features of the item being described. (5) • Recognize that numbers can be used to count a collection of things. (6) • Measure the lengths of objects using non-standard methods of measurement (e.g., teddy bear counters and pennies). (8) • Make pictographs and use them to describe observations and draw conclusions. (9)	• Work in a small group to complete an investigation and then share findings with others. (4) • Create individual conclusions about group findings. (5) • Make estimates to compare familiar lengths, weights and time intervals. (7) • Use oral, written and pictorial representation to communicate work. (8) • Describe things as accurately as possible and compare with the observations of others. (9)	• Use evidence to develop explanations of scientific investigations. (What do you think? How do you know?). (5) • Recognize that explanations are generated in response to observations, events and phenomena. (6) • Use whole numbers to order, count, identify, measure and describe things and experiences. (9) • Share explanations with others to provide opportunities to ask questions, examine evidence and suggest alternative explanations. (10)

Correlation of Benchmarks and Indicators
Prekindergarten — 2

Scientific Ways of Knowing Standard

Pre-K – 2 Benchmark

A. Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Offer ideas and explanations (through drawings, emergent writing, conversations, movement) of objects, organisms and phenomena, which may be correct or incorrect. (1)	• Recognize that scientific investigations involve asking open-ended questions. (How? What if?) (1) • Recognize that people are more likely to accept your ideas if you can give good reasons for them. (2)	• Discover that when a science investigation is done the same way multiple times, one can expect to get very similar results each time it is performed. (1) • Demonstrate good explanations based on evidence from investigations and observations. (2)	• Describe that scientific investigations generally work the same way under the same conditions. (1)

Correlation of Benchmarks and Indicators

Prekindergarten — 2

Scientific Ways of Knowing Standard

Pre-K – 2 Benchmark

B. Recognize the importance of respect for all living things.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Recognize the difference between helpful and harmful actions toward living things (e.g., watering or not watering plants). (2)	• Interact with living things and the environment in ways that promote respect. (3)	No indicators present for this bench.	• Describe ways in which using the solution to a problem might affect other people and the environment. (3)

Correlation of Benchmarks and Indicators

Prekindergarten — 2

Scientific Ways of Knowing Standard

Pre-K – 2 Benchmark

C. Recognize that diverse groups of people contribute to our understanding of the natural world.

Prekindergarten Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
• Participate in simple, spontaneous scientific explorations with others (e.g., digging to the bottom of the sandbox, testing materials that sink or float). (3)	• Demonstrate ways science is practiced by people every day (children and adults). (4)	• Explain that everybody can do science, invent things and have scientific ideas no matter where they live. (3)	• Explain why scientists review and ask questions about the results of other scientists' work. (2) • Demonstrate that in science it is helpful to work with a team and share findings with others. (4)

Effective teachers of science not only provide a supply of engaging, relevant materials, but they also give learners conceptual support. They state what is known; paraphrase, redirect and question ideas and approaches; provide information for students' considerations (or arrange for learners to have access to a source that provides information); and assist with problem solving. Tinkering is pivotal to later investigation, as it provides the basis for which children formulate questions and set about finding answers.

– Janice Yelland, 2000

Science

Instructional Commentary

Science in the Early Years

It is instinctive for young children to search out, describe and explain patterns of events experienced in the natural and physical world. Children develop an understanding of science as they investigate and interact with real objects and phenomena. They are natural scientists – curious, observant and questioning. Their knowledge of science grows out of an attempt to find meaning in their environment and by relating new experiences to prior knowledge and personal experience.

Science content is more than isolated facts such as the stages in the life of a butterfly or the life cycles of a plant. Although scientific facts are important, it is how the information is organized into meaningful concepts and ideas that is of significance for the learner. For example, learning about the development of a butterfly should lead to the big idea that all living things develop in a series of stages called a life cycle.

The process of science is learned through active engagement. Preschool children learn science by exploring the world around them. When provided an environment with varied materials, they try out things to see how they work, they experiment, they manipulate, they are curious and they ask questions. As they seek answers to their questions, opportunities are provided for hypothesizing and predicting, observing, collecting data over time and formulating conclusions. Through active engagement in authentic and meaningful science experiences, they learn to enjoy and appreciate their surroundings.

The science curriculum provides for a balance among the three broad disciplines of life science, physical science and Earth/space science. Thematic units or topics of study, arising for the interest of children, are used to plan meaningful experiences in which children explore ideas, manipulate materials and engage in conversations to construct their own understanding of science.

Children need opportunities to present their views to other children and adults through their drawings, constructions and verbal exchanges. By exchanging opinions with others, children begin to move from an egocentric point of view and compare their views with those of others. Their concepts about the natural world are expanded and enhanced through sharing of experiences.

Inquiry in Early Childhood Education

"Science inquiry" refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world."

National Research Council, 1996

Young children naturally are inclined to discover how the world works. Their natural curiosity enables them to develop the skills of inquiry within a context of meaningful experiences and real-life investigations. These skills develop as children observe phenomena in the natural world and question: "Why?" An astute teacher will support learning not by *answering* the children's questions, but by encouraging them further to ask "How?" and better yet, "How can we find out?"

Engaging children in the process of discovery supports the development of research skills. These skills include: exploring objects, materials and events; sorting, classifying, ordering; using tools to support their observations and experiments; recognizing patterns, making predictions, interpreting data and drawing conclusions. Scientific inquiry in the early childhood classroom also encourages collaboration and communication as children work together to share ideas, discuss processes and compare findings. Scientific inquiry is cyclical, since children's findings often give rise to new observations – and yet more questions – thus allowing them to explore areas of intense interest more deeply over extended periods of time.

According to the National Science Education Standards, "The central distinguishing characteristic between science and technology is a difference in goal: the goal of science is to understand the natural world, the goal of technology is to make modifications in the world to meet human needs" (National Research Council, 1996). Children engaged in scientific inquiry may use their knowledge and understandings of how the world works to create something new or to adapt something in the classroom to meet a particular need or to solve a problem. Teachers use "design technology" to foster a sense of accomplishment by supporting children's creative ideas, offering a variety of new and different materials, such as clay or wire, and by encouraging children to use common materials in new ways.

In addition to these more concrete skills of observation and investigation, scientific inquiry fosters the development of important dispositions that will serve not only in science, but in all content area and contexts. The most important of these dispositions is the sense of wonder. In addition, teachers should encourage children's curiosity, questions and perseverance. Perseverance empowers children to accept the challenges, work through the problems of an investigation, achieve a satisfying result and experience the resulting sense of pride and accomplishment. Scientific inquiry allows children to build connections, so they not only *know*, but they also know *how they know*. Finally, scientific inquiry fosters a sense of respect and appreciation for the beauty and complexity of the natural world, for ideas, for evidence and data, and for collaboration within a learning community (Worth and Grollman, 2003).

Planning for Instruction

The vignette and activity presented in this section show examples of classroom implementation of Ohio's Early Learning Content Standards for Science within the context of daily routines and activities. They illustrate how two teachers designed learning experiences to help children develop the knowledge and abilities identified in the standards, benchmarks and indicators. These examples can serve as starting points for discussion about instructional planning and implementation of the standards. In successful early childhood classrooms, the curriculum will be mapped to the standards and each experience will address many indicators identified across the standards in science and other content areas, thus integrating learning opportunities for children.

Benchmarks in each standard provide the goals for what students should know and be able to do by the time they reach the end of a grade-level band. While engaging children in these science experiences, the early childhood teacher uses the prekindergarten indicators as checkpoints for the specific knowledge and skills young children can demonstrate as a result of their learning experiences and intentional teaching. Early childhood educators should review the benchmarks for science to determine what children should be able to do by the end of their second-grade year, drawing appreciation of their role in the continuum of children's education.

The following sequence of experiences serves as an example and needs to be modified to follow children's interests and serve individual educational needs. The context for the lesson begins during large or small group time while the children and teacher are engaged in reading and talking about a story together, leading to a hypothesis about how seeds travel and grow. The sequence of experiences that follow might emerge as a function of children's continued interest and investigations. Consequently, the inquiry might occur over the course of several days. The primary focus of the lesson and supporting experiences is on indicators found within the scientific inquiry standard. However, as the teacher strives to extend children's learning, he or she also supports other standards and indicators in this planned experience.

Catching Seeds with Socks!

Standard: Scientific Inquiry

Pre-K-2 Benchmarks:

A. Ask a testable question.

B. Design and conduct a simple investigation to explore a question.

C. Gather and communicate information from careful observations and investigation through a variety of methods.

Indicators:

1. Ask questions about objects, organisms and events in their environment during shared stories, conversations and play (e.g., ask about how worms eat).
2. Show interest in investigating unfamiliar objects, organisms and phenomena during shared stories, conversations and play (e.g., Where does hail come from?).

3. Predict what will happen next based on previous experiences (e.g., when a glass falls off the table and hits the tile floor, it probably will break).
5. Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).
8. Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance.

Purpose of activity:

The experiences within the following activity are designed to provide opportunities for children to investigate, discover and represent their understanding about how seeds travel, what plants need and how they grow.

Materials needed:

- Children's literature (story or informational text) about seeds or plant life;
- Socks for each child (old, used white socks are best);
- Styrofoam trays for each child;
- Magnifying glasses or lenses;
- Spray bottles;
- Measuring devices (rulers, string, paper strips);
- Writing materials and paper;
- Chart paper and markers;
- Variety of media to record/represent experience: art supplies, clay, digital camera, etc.

Procedure:

- During group time following the reading of a storybook or informational text about plants (e.g., *The Carrot Seed,* by Ruth Krauss), facilitate a discussion about what the children know about plants and seeds – what seeds look like, how seeds travel, how plants grow and what materials are needed to plant and care for seeds.
- As the children brainstorm, create a web (diagram) to record their responses and document their background knowledge. While recording responses, help children form a hypothesis about how seeds travel, what plants need and how they grow.
- Describe the following procedure of catching seeds with socks to the children. Show the materials that they will use and ask probing questions to stimulate interest and inquiry into the experience (i.e., What do you think will happen if you walk around outside wearing a sock over your shoe? What do you think you might find on the sock? How could things like seeds get on a sock?). Accept and record children's responses on chart paper.
- Set up the investigation through the following procedure:
    * Take children outside.

  * Have each child put a sock over one shoe.
  * Go for a walk through an overgrown or densely vegetated area that is slightly damp (e.g., grass, mud, field, edges of flower beds or woods).
  * After the walk, have each child remove the sock and gently place the sock on an individual Styrofoam tray before going inside the building. Caution children to be careful not to shake the sock or blow anything off it. Teacher note: Seeds are likely to be on *top* of the sock, since seeds collected by this method are those that cling.

- Back in the learning setting, provide magnifying glasses and allow time for children to closely examine what they find on their socks. Help children identify their findings, leaving all materials on the socks. Talk about what seeds look like, paying particular attention to features that enable seeds to disperse (travel) and to cling to things. (The way seeds cling to the socks is called *adhesion*.)
- Record the children's findings in categories, (e.g., various kinds of seeds, plant fragments, stones, dirt). This record could be a graph.
- Return to the web and ask children what they think the next steps should be for germinating (sprouting) the seeds on the socks. Discuss what the seeds on the socks might need in order to grow. Accept all responses. Build on children's ideas to develop a plan, including how to provide such things as sunlight, water and soil. Point out that some of the seeds on the sock may be in dirt, while others may be without dirt.
- Place the trays in a sunlit area conducive to germinating seeds, such as on a window sill. Provide spray bottles so that children can water their socks every day. Devise a system with the children for recording the days and the watering. Help children do their own recording.
- Ask children what they predict will happen. Now and then, revisit the web to make corrections, additions and revisions as the children observe the growth process.
- Record significant events as they occur. At appropriate times, discuss the stages of plant life: seed, seedling, plant. Discuss differences in germination patterns as children notice such features as plants with one leaf (monocots) and plants with two leaves (*dicots*).
- Invite children to pose questions and discover answers. For example, in response to, "How many days will it take the seeds to germinate?" the teacher may want to introduce the tally system to keep track of passing days until the sprouts appear on the socks.
- Make available investigative tools, such as magnifying lenses, and a variety of resources the children can use to find information and answers to their questions, such as books, magazines, software programs, specimen collections or samples.
- Throughout the project, provide materials such as a digital camera, writing, drawing and art supplies so that children can document daily changes and chart what they observe.
- Ask children to represent what they know and have discovered through art, photography, pantomime, writing or creating models to document their own learning.

- At the conclusion of the project, revisit the original web and make any needed additions of new information. Have children compare what they know about how seeds travel, how plants grow and what materials are needed with their original hypothesis.
- With the children, create a documentation product, such as a picture panel with narratives, to share this lesson with parents and others.
- When appropriate, have children take their sock plant home.

Extensions:

- Try this experiment at different times of the year and/or walk in different areas and compare results.
- Create a seed catcher to catch seeds that travel with the wind.
- Repot the sprouts from the socks and grow them to full size.
- Bury vegetable seeds with quick germination rates and plant them in a variety of ways: in dirt, on paper towels, on clay, in sun, in shade, with water, without water, or any combination. Follow the same procedures for study as in this lesson.
- Read books about plants in other areas. Pose questions such as, "What are other ways that seeds may travel?"

Note: As a result of this experience, the following standards and indicators within other content areas are also addressed:

Content Area: English Language Arts

Standard: Research

Indicators:
2. Use a variety of resources to gather information with assistance (e.g., picture/word games, informational picture books).
4. Share findings of information through retelling, media and play (e.g., draw a picture of the desert).

Standard: Acquisition of Vocabulary

Indicators:
1. Understand the meaning of new words from context of conversations, the use of pictures that accompany text or the use of concrete objects.

Content Area: Mathematics

Standard: Measurement

Indicators:
4. Begin to use terms to compare the attributes of objects (e.g., bigger, smaller, lighter, heavier, taller, shorter, more and less).

Standard: Data Analysis and Probability

Indicators:
1. Gather, sort and compare objects by similarities and differences in the context of daily activities and play (e.g., leaves, nuts, socks).

The following vignette illustrates how the study of shadows emerged from a "teachable moment." The experiences described demonstrate the reality that children are surrounded by interesting science phenomena that may spark their interest at any time. The primary focus of the intentionally planned and supported experiences will be on indicators found within the physical science standard – understanding the nature of sunlight as a source of energy and change on the environment.

Ms. Thomas and her 18 preschool-age children had created their own garden right outside the back door of the classroom. Following the class discussion about the garden needing sunlight for the seeds and plants to grow, it was Colin, an inquisitive 4 year old, who first started noticing the shadows. A group of children were outside in the early afternoon when they actually saw a crisp line gradually crawl over the garden. "Look, a shadow," he said, pointing. Ms. Thomas confirmed, "Wow, you're right." She then asked the children, "What do you think a shadow is anyway?" "It follows you," Costanza said. "The sunlight makes it happen because it's so bright," Lei-Ann said, "Shadows go away in the night." But Jeff disagreed. He said, "Uh-oh – sometimes you can see them." Ms. Thomas wrote down their ideas and hung them up in the classroom, so they could revisit them later.

The next time the class was outside, a group of children started playing with their shadows, running away from them, jumping and waving their arms to see the shadows wave. For a number of children, making castles and birthday cakes in the sandbox was replaced by shadow play – seeing how many times they could step on each other's shadow or have their shadows touch hands. Some discovered they could make monster shadows, too, with four legs and four arms and antenna. Initially, the younger children, in particular, seemed to be convinced that their shadows were always there – that they were really a part of them. But seeing their shadows actually disappear when they ran into the shade made them wonder.

Given the children's interests and with standards in mind, Ms. Thomas decided to provide opportunities for the children to explore shadows more deeply, focusing on how shadows change and what makes them change. To support their investigations, she engaged her young children in tracing their shadows on big poster paper at different times throughout the day to then measure and talk about the changes in shadows and the reasons for the change. A shadow theater was created with fabric stretched across a door frame and a light source placed in back of the "theater." The children were fascinated and exuberant as they played behind the sheet to make "indoor" shadows, puppets and plays using puppets, their bodies or just their hands. Finally, storybooks with "shadow" themes and informational books were shared and made accessible throughout the learning setting, for the teacher and children to reference to support their ideas and findings (Worth and Grollman, 2003).

The preceding lesson and vignette are just two examples of early childhood educators' plans for and implementation of standards-based teaching and learning. The early learning content standards serve to drive and inform curriculum, instruction and appropriate learning environments – the context for planning and implementing developmentally appropriate and effective teaching practices to support the development of *all* young children in the area of science.

Guidance for Early Learning Content Standards Implementation is an essential companion tool for educators of children ages 3 to 5. This document provides assistance in the design and implementation of meaningful curricula — intentional early learning experiences and practices aligned to standards-based indicators. The list of strategies and ideas to support young learners serves as a starting point for thoughtful curriculum design and teaching practices. Access this document online at http://www.ode.state.oh.us, keyword search: *guidance early learning*, or contact the Documents Resource Center of the Ohio Department of Education at (614) 728-3471 or toll-free at 1-877-644-6338.

We learn through our senses, the ability to see, feel, hear, smell and taste provides the contact between us and the environment... The greater the opportunity to develop an increased sensitivity and the greater the awareness of all the senses, the greater will be the opporunity for learning.

– Viktor Lowenfeld and W. Lambert Brittain, 1975

Science

Glossary

balance – An instrument for measuring mass.

body covering – Feature that covers the body, such as fur or feathers.

characteristic – A distinguishing trait, feature, quality or property.

chrysalis – The pupa of a butterfly and some other insects.

classification – Systematic arrangement in groups or categories according to established criteria.

climate – The average course or condition of the weather at a place, usually over a period of years, as exhibited by temperature, wind velocity and precipitation.

comet – A celestial body that consists of a fuzzy head usually surrounding a bright nucleus, and that usually has a highly eccentric orbit. When in the part of its orbit near the sun, the body often develops a long tail that points away from the sun.

conservation – A careful preservation and protection of something; especially planned management of a natural resource to prevent exploitation, destruction or neglect.

current – Continuous flow of air, water or electric charge.

cycle – An interval of time during which a sequence of a recurring succession of events or phenomena is completed.

energy – The capacity for doing work; can be in various forms such as nuclear, sound, thermal and light.

environment – The complex physical, chemical and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival.

evaporation – To convert into vapor.

evidence – Facts or observations on which a conclusion can be based.

extinct – A species of organism that no longer exists.

floor or table graph – A graph made of actual objects arranged in categories on a tabletop or on the floor.

food chain – An arrangement of the organisms of an ecological community according to the order of predation in which each uses the next, usually lower, member as a food source.

force – An influence that, if applied to a free body, results chiefly in an acceleration of that body in the direction of its application.

fossil – Remnant, impression or trace of an organism of past geologic ages that has been preserved in the Earth's crust.

friction – The force that resists relative motion between two bodies in contact.

galaxy – Any of the very large groups of stars and associated matter that are found throughout the universe.

gas – A fluid (such as air) that has neither independent shape nor volume, but tends to expand indefinitely.

germination – The beginning of growth in a spore, seed, zygote, etc., especially following a dormant period.

gravity – The gravitational attraction of the mass of the Earth, the moon or a planet for bodies at or near its surface.

habitat – The native environment of an animal or plant, or the kind of place that is natural for an animal or plant.

hypothesis – A formula derived by inference from scientific data that explains a principle operating in nature.

inquiry – The process that consists of principles and procedures for the systematic pursuit of knowledge, involving the formulation of a problem or hypotheses and the collection of data through observation and experiment.

landform – A natural feature of a land surface.

life – An organism that has the capacity for metabolism, growth, reaction to stimuli and reproduction.

life cycle – A series of stages through which an animal or plant passes during its lifetime.

liquid – A fluid, such as water, that has no independent shape but has a definite volume, does not expand indefinitely and that is only slightly compressible.

mass – The property of a body that is a measure of its inertia and that is commonly taken as a measure of the amount of material it contains, causing it to have weight in a gravitational field.

matter – Material substance that occupies space, has a mass and is composed of atoms consisting of protons, neutrons and electrons, that constitutes the observable universe, and that is interchangeable with energy.

meteor – Any of the small particles of matter in the solar system that are directly observable only by their incandescence from frictional heating on entry into the atmosphere.

Milky Way – A broad, luminous, irregular band of light that stretches completely around the celestial sphere and is caused by the light of myriads of faint stars.

mineral – A solid homogeneous crystalline chemical element or compound that results from the inorganic processes of nature.

moon cycle – The cycle of the moon's phases, from new to full and back.

natural – Existing in, or produced by, nature.

natural resource – A productive resource supplied by nature (e.g., ores, trees, arable land).

natural world – Refers to all living components (animals and plants) in the world.

nesting – To build or occupy a nest; settle in.

observe – To watch carefully, especially with attention to details or behavior, for the purpose of arriving at a judgment.

orbit – A path described by one body in its revolution about another (as by the Earth about the sun or by an electron about an atomic nucleus).

organism – Any living thing.

patterns – Designs that repeat themselves, including patterns of sounds and physical movements (e.g., clap, stomp, clap, stomp…); patterns in the environment (e.g., day follows night, repeated phrases in storybooks, patterns in carpeting or clothing); patterns in numbers or symbols (e.g., 1-2-3, 1-2-3…or aabccd, aabccd…).

phenomenon – A fact or event of scientific interest susceptible to scientific description and explanation.

physical change – A change in a substance that does not alter its chemical makeup.

physical properties – A property of materials that can be observed without changing the chemical makeup of the material.

physical world – Refers to all nonliving components in the world (e.g., air, water, sun, light, rocks, soil and other formations and materials).

pictograph – A diagram or graph using pictured objects to convey ideas or information.

pitch – The property of a sound, especially a musical tone, that is determined by the frequency of the waves producing it; highness or lowness of sound.

planet – Any of the large bodies that revolve around the sun in the solar system.

pollution – A substance that, when added to the environment, causes the environment to be harmful or unfit for living things.

precipitation – A deposit on Earth of hail, mist, rain, sleet or snow.

predator – An animal that lives by capturing prey as a means of maintaining life.

predict – Use of prior knowledge to guess what an outcome will be.

prey – An animal taken by a predator as food.

property – A quality or trait belonging to an individual or thing.

react – To undergo a chemical reaction.

recycle – The process used to regain materials for human use; the salvage and reprocessing of used materials, such as paper, metals, glass and cloth.

reflection – The throwing back by a body or surface of light, heat or sound without absorbing it.

repel – To force away or apart, or tend to do so by mutual action at a distance.

replicate – To duplicate experiments, procedures or samples.

representation graph – Pictures of real objects placed on a wall or chalkboard.

rotation – The turning of a body about its long axis, as if on a pivot.

scavenger – An organism that habitually feeds on refuse or carrion.

scientific law – A statement of an order or relation of phenomena that, so far as known, is invariable under the given conditions.

scientific method – Principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experimentation, and the formulation and testing of hypotheses.

senses – Any faculty receiving impressions through body organs (i.e., sight, touch, taste, smell or hearing).

solid – A substance that does not flow perceptibly under moderate stress, has a definite capacity for resisting forces (such as compression or tension) that tend to deform it, and under ordinary conditions retains a definite size and shape.

sound waves – Mechanical radiant energy, such as air, that is transmitted by longitudinal pressure waves in a material medium and is the objective cause of hearing.

species – A group of organisms consisting of similar individuals capable of exchanging genes or interbreeding.

star – A natural luminous body visible in the sky, especially at night.

structure – The arrangement of particles or parts in a substance or body.

survival – The continuation of life or existence.

temperature – The degree of hotness or coldness of anything.

tool – A device that aids in accomplishing a task, a form of technology.

velocity – rate of change of position and direction with respect to time.

water cycle – The sequence of conditions through which water passes from vapor in the atmosphere through precipitation upon land or water surfaces and ultimately back into the atmosphere as a result of evaporation and transpiration.

weather – The state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

weight – The amount of heaviness of a solid (e.g., objects, animals, people).

The job of a teacher is to excite in the young a boundless sense of curiosity about life, so that the growing child shall come to comprehend it with an excitement tempered by awe and wonder.

– Quoted by Garrett in *Peter*, 1977

Science

Resources

These resources can be used to aid in understanding content standards and to begin implementing standards-based instruction and assessment. The Instructional Management System (IMS) developed by the Ohio Department of Education provides opportunities to explore best practices, research-based instruction and effective lessons and strategies for all children and students. Access this resource online at http://www.ode.state.oh.us, keyword search: *Ohio's Instructional Management System*.

Instructional Resources

Resources listed in this section provide information for educators seeking practical and creative ways to implement the standards-based instruction.

Instructional Resources on the Internet

- Ohio Resource Center – The Ohio Resource Center for Mathematics, Science and Reading (ORC) provides links to peer-reviewed instructional resources that have been identified by a panel of Ohio educators as exemplifying best or promising practices. Available resources also include content and professional resources, as well as assessment and general education resources that will support the work of teachers in prekindergarten through grade 12 and higher education faculty members. The resources are correlated with Ohio's academic content standards and with applicable national content standards. http://www.ohioorc.org
- Resources for Early Childhood - The REC website seeks to support Ohio's early childhood teachers, parents, teachers of early childhood teachers, and children by providing peer-reviewed Web-based resources to assist with instructional planning, professional learning, and implementing the Ohio Early Learning Content Standards for mathematics, science, English language arts and social studies. The REC is a dynamic Web site with a rotation of new book recommendations, parent connections, and classroom resources featured on the home page. Best practice articles are published each month to support educators and enrich their teaching. Documentation of interdisciplinary projects that have been integrated into the programs of many Ohio preschool and children's centers are also featured on the Web site. http://www.rec.ohiorc.org
- Exploratorium Bubbularium (1998) http://www.exploratorium.edu/science_explorer/bub_domelhtml
- Image of the earth and moon taken from Galileo, courtesy of NASA. http://scilitlinks.org/bubbles.htm

Instructional Publications

- Brown, S. (2004). *Bubbles, rainbows and worms: Science experiments for preschool children*. Beltsville, MD: Gryphon House.
- Chalufour, I., & Worth, K. (2004). *Building structures with young children*. St. Paul, MN: Redleaf Press.
- Chalufour, I., & Worth, K. (2005). *Exploring water with young children*. St. Paul, MN: Redleaf Press.

- Griffin, S. (2004). *My big world of wonder: Activities for learning about nature and using natural resources wisely*. St. Paul, MN: Redleaf Press.
- Moomaw, S., & Hieronymus, B. (1997). *More than magnets: Exploring the wonders of science in preschool and kindergarten*. St. Paul, MN: Redleaf Press.
- Ohio Department of Education, Office of Early Learning and School Readiness. (2005). *Guidance for early learning content standards implementation*. Columbus: Ohio Department of Education.
- Seefeldt, C., & Galper, A. (2000). *Active experiences for active children: Science*. Columbus, OH: Merrill Prentice Hall.
- Seefeldt, C. (2005). *How to work with standards in the early childhood classroom*. New York: Teachers College Press.
- Starbuck, S., Olthof, M., & Midden, K. (2002). *Hollyhocks and honeybees: Garden projects for young children*. St. Paul, MN: Redleaf Press.
- Trundle,K. C., & Troland, T. H. (2005). "The moon in children's literature." *Science and Children*.
- Worth, K., & Grollman, S. (2003). *Worms, shadows and whirlpools: Science in the early childhood classroom*. Washington, DC: NAEYC.

Professional Resources

Resources listed in this section provide access to professional organizations and public institutions, to afford educators opportunities to stay informed within their fields.

Professional Organizations

- National Association for the Education of Young Children (NAEYC) – NAEYC exists for the purpose of "leading and consolidating the efforts of individuals and groups working to achieve healthy development and constructive education for all young children. Primary attention is devoted to assuring the provision of high quality early conferences and forums that provide professional development and resources that address early science and other relevant issues." http://www.naeyc.org
- Ohio Department of Education, Office of Early Learning and School Readiness. http://www.ode.state.oh.us, search keywords: *early learning*.
- U. S. Department of Education, http://www.ed.gov

Research Resources

Resources listed in this section provide theory, skills and strategies to build knowledge and understanding of standards and other related topics.

Research Publications

- National Research Council. (2002). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington, DC: National Academy Press.
- Seefeldt, C., & Galper, A. (2000). *Active experiences for active children: Science*. Columbus, OH: Merrill Prentice Hall.
- Worth, K., & Grollman, S. (2003). *Worms, shadows and whirlpools: Science in the early childhood classroom*. Washington, DC: NAEYC.

Children's Picture Books

The children's literature titles listed in below are examples of useful picture books and age-appropriate fiction and nonfiction for supporting young learners' understanding of early science.

- *Air* by Kitty Benedict
- *Air Is All Around You* by Franklin Branlly
- *Autumn Leaves* by Ken Robbins
- *A Butterfly Is Born* by Melvin Berger
- *The Carrot Seed* by R. Kraus
- *Changes, Changes* by Pat Hutchins
- *The Cloud Book* by Tomie dePaola
- *Color Dance* by Ann Jonas
- *Come to the Meadow* by A. Hines
- *Dear Rebecca, Winter Is Here* by Jean Craighead George
- *Earthworm* by Andrienne Soutter-Perrot
- *Feel Better, Ernest* by Gabrielle Vincent
- *First Flight* by David McPhail
- *The First Snowfall* by Anne Rockwell
- *The Five Senses* by Aliki
- *Floating and Sinking* by Terry Jennings
- *The Floating House* by Scott Sanders
- *Force and Motion* by Peter Lafferty
- *Free Fall* by D.Weisner

- *From Caterpillar to Butterfly* by D. Heilegman
- *Germs Make Me Sick* by Melvin Berger
- *Gravity* by Linda Cornwell
- *The Green Grass Grows All Around* by H. Hoffman
- *How's the Weather?* by Rozanne Williams
- *If It's Disgusting, We Eat It* by James Solheim
- *Is It Rough? Is It Smooth? Is It Shiny?* by Tanya Toban
- *It's Melting* by Rozanne Williams
- *It's Raining, It's Pouring* by K. Eagle
- *Keeping Your Balance* by Julian Rowe
- *Kids for the Earth* by Melvin Berger
- *The Life Cycle of the Honey Bee* by Paula Z. Hogan
- *The Listening Walk* by Paul Showers
- *The Look Book* by Janet Moncure
- *Louis and the Night Sky* by Nicola Morgan
- *Mirandy and Brother Wind* by Patricia McKissack
- *The Mixed-Up Chamelion* by Eric Carle
- *Mother, Mother, I Feel Sick* by Remy Charlip
- *Mouse Paint* by Ellen Stoll Walsh
- *My Many Colored Days* by Dr. Suess
- *Night in the Country* by Cynthia Rylant
- *Noses Are for Smelling* by Eve Morel
- *Planting a Rainbow* by Lois Ehlert
- *Pumpkin, Pumpkin* by J. Titherington
- *The Rains are Coming* by Sanna Stanley
- *The Science Book of Sound* by Neil Ardley
- *The Seasons of Arnold's Apple Tree* by G. Gibbons
- *Sky Above, Earth Below* by J. Cother
- *Snowballs* by Lois Ehlert
- *A Snowy Day* by Ezra Jack Keats
- *Sounds All Around Us* by Wendy Pfeffer
- *A Tasting Party* by Janet Moncure
- *Tasting Things* by Allan Fowler
- *This Year's Garden* by C. Rylant
- *The Tiny Seed* by Eric Carle
- *The Touch Book* by Janet Moncure
- *Touch, Taste and Smell* by Steve Parker

- *Transport on Land, Road, and Rail* by Eryl Davies
- *Trees* by P. Gavan
- *Twilight Comes Twice* by Ralph Fletcher
- *The Very Hungry Caterpillar* by Eric Carle
- *Walk with Your Eyes* by Marcia Brown
- *The Ways Things Work* by David Macaulay
- *What Color Is Camouflage?* by Carolyn Otto
- *What Color Was the Sky Today?* by M. Ford
- *What Makes a Magnet?* by F. Branley
- *The Wheeling and Whirling Around Book* by Judy Hindley
- *Wheels* by Byron Barton
- *Who Eats What?* by Patricia Lauber
- *Who's Sick Today?* by Lynne Cherry
- *Why Do Birds Fly South?* by Chris Arvtis
- *The Wind Blew* by Pat Hutchins
- *Winter at Long Pond* by William T. George

all children are born ready to learn

relationships are influential

communication is critical

environments matter

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